

“Why are we protecting source water?” The public health connection.

Jeffrey K. Griffiths, MD MPH&TM

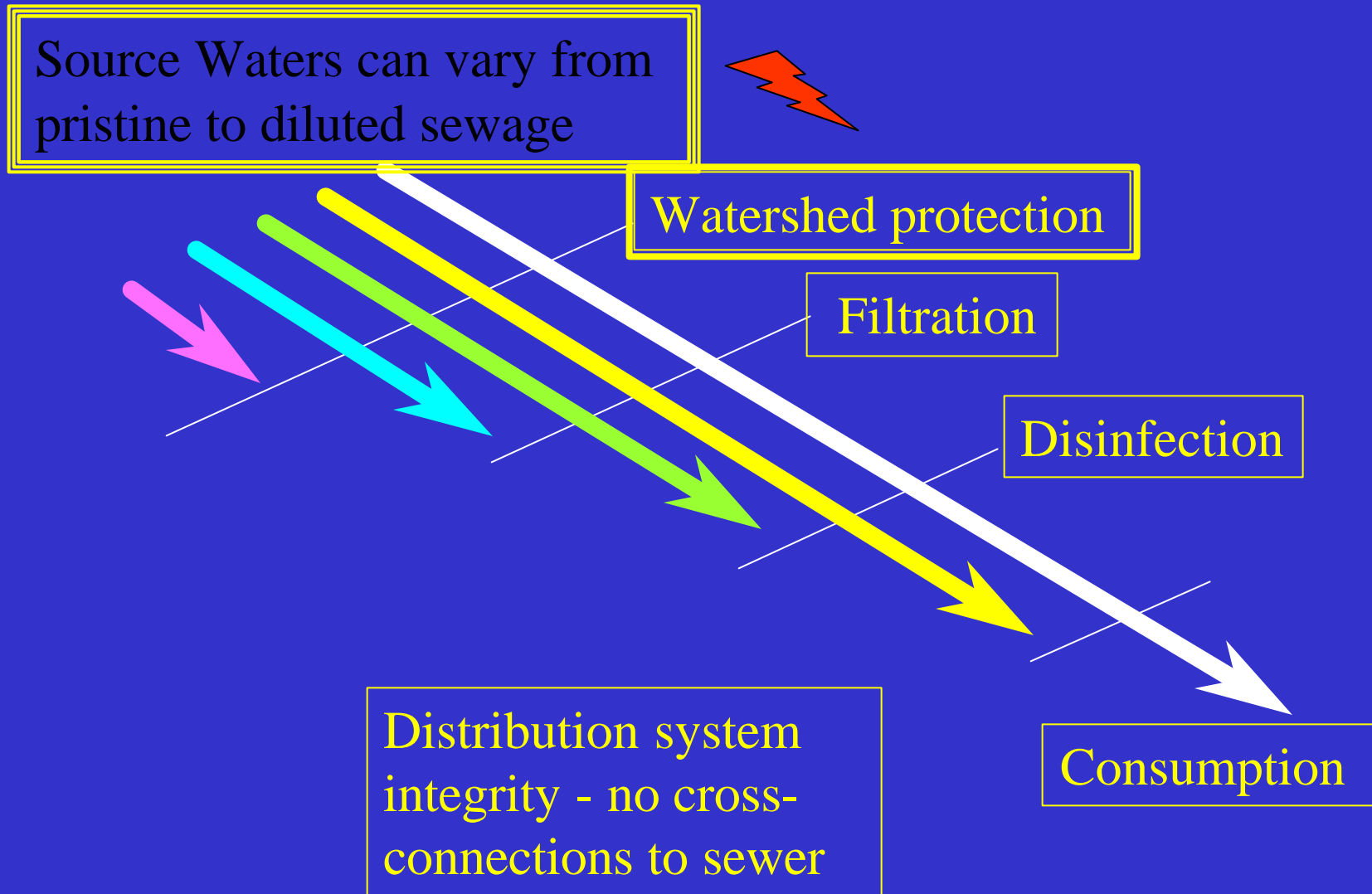
Director, Graduate Programs in Public

Tufts University School of Medicine

Member, National Drinking Water Advisory Council



'Multiple Barriers' Concept

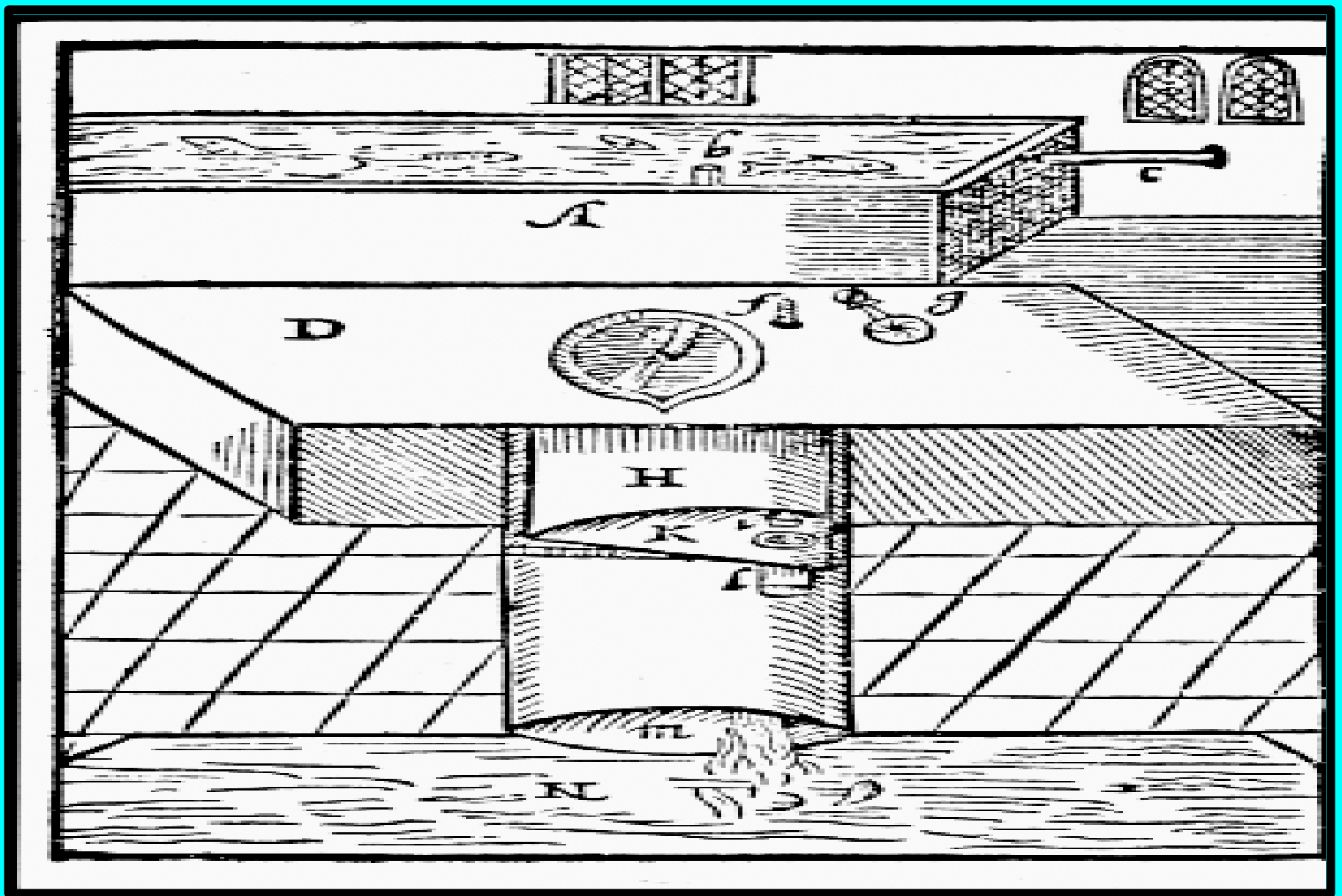


Things are better – 1900 on

And source water protection

- **Life expectancy** has increased by 30+ years over the last 100 years.
- **Water treatment, sewerage, safe food** - 2/3rds of this increase. Some benefit from vaccines and antibiotics.
- New medicines, intensive care, etc - little or no impact on overall lifespan.

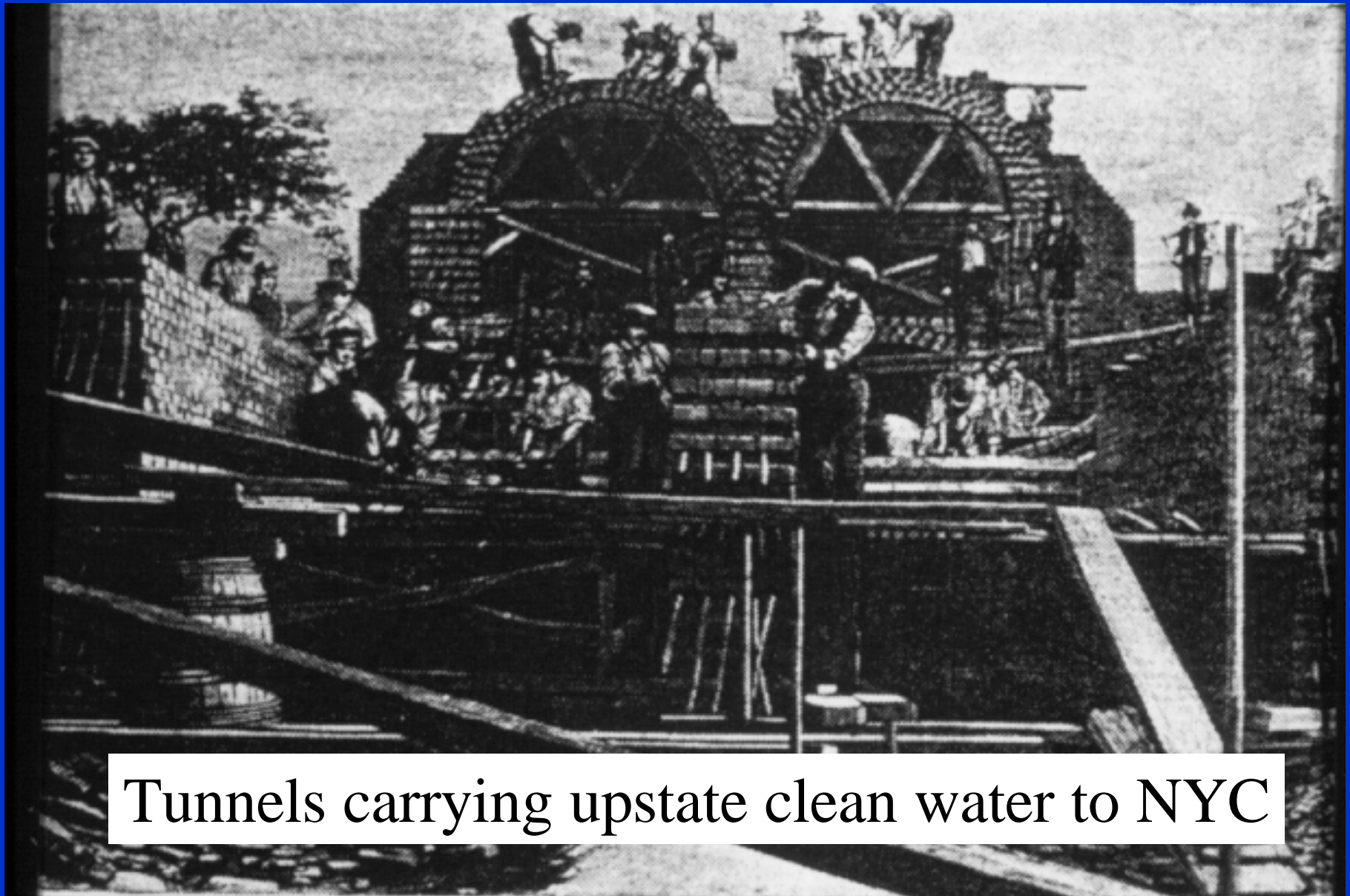
**Rule #1. Keep shit out of your
drinking water.
(e.g. have good source water)**



The Romans partly got it: they had sewerage

US was a developing country:
death from diarrhea was common
> 10% died before 1 year old





Tunnels carrying upstate clean water to NYC

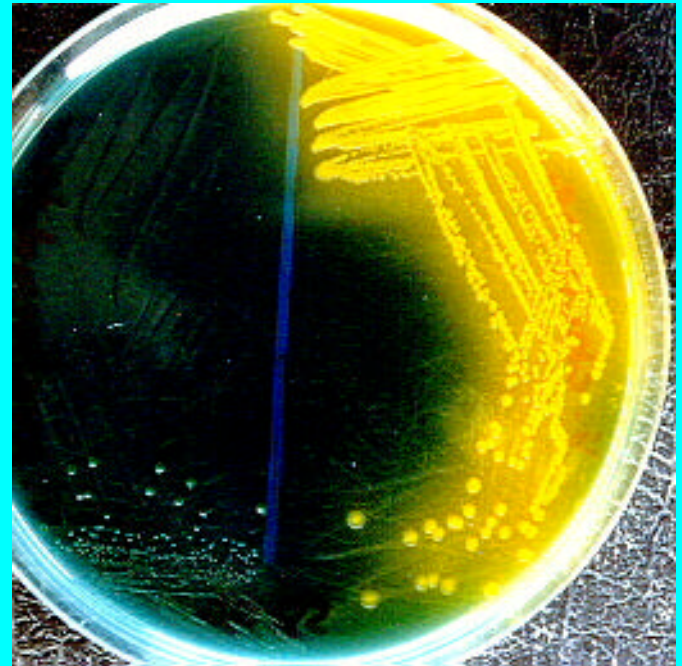
Value of Source Water Protection in 1905

- **Typhoid rates 1905:**

**Groundwater
18/100,000 per year**

**Flowing Water
62/100,000 per year**

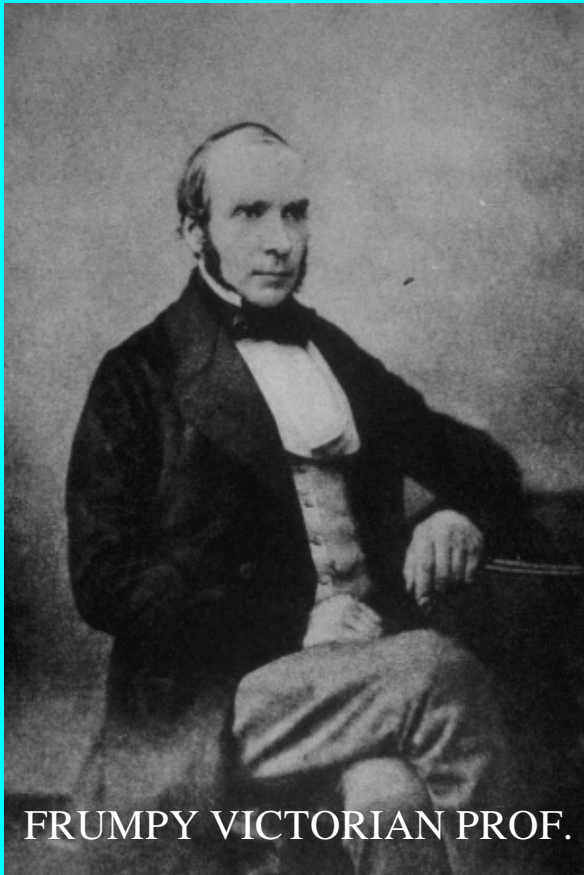
(now: 0.3/100,000)



Rule #1. Keep shit out of your drinking water.

Rule #2. If you can't keep shit out of your water, kill the bacteria in the water.

Filtration and chlorination were tied to advances in microbiology



It was
Cleanliness
against
Cholera and
Yellow Fever



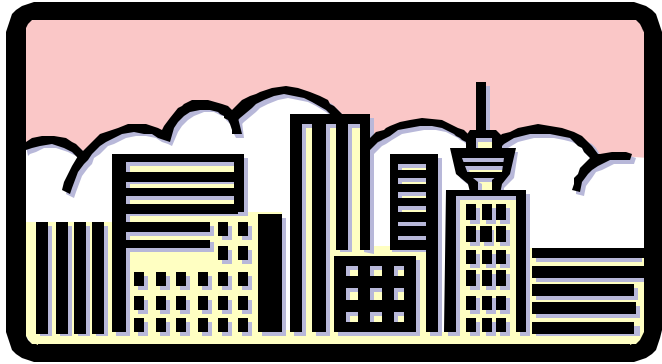
What did chlorination accomplish 1910-1925?

- **Decreased US cholera by 90%**
- **Decreased US typhoid by 80%**
- **Decreased US leptospirosis by 80%**
(urine of infected rodents)
- **Began chronic exposure to low levels of halogenated chemicals in DW.**

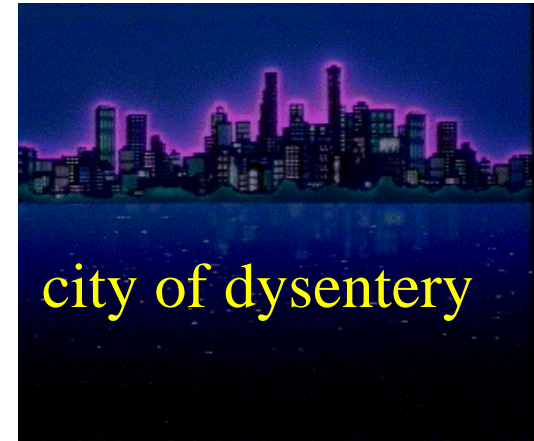
The Bargain Of A Century Ago

- The effectiveness of combined filtration and chlorination reduced the impetus for source water protection.
- In many cities or towns, cheaper to treat water than to secure a protected source; in some places, opposite was the case.
- **Now times have changed:** Water demand has outstripped population growth: water was cheap and plentiful – but no more...

Who, What, Where, When... the key factors



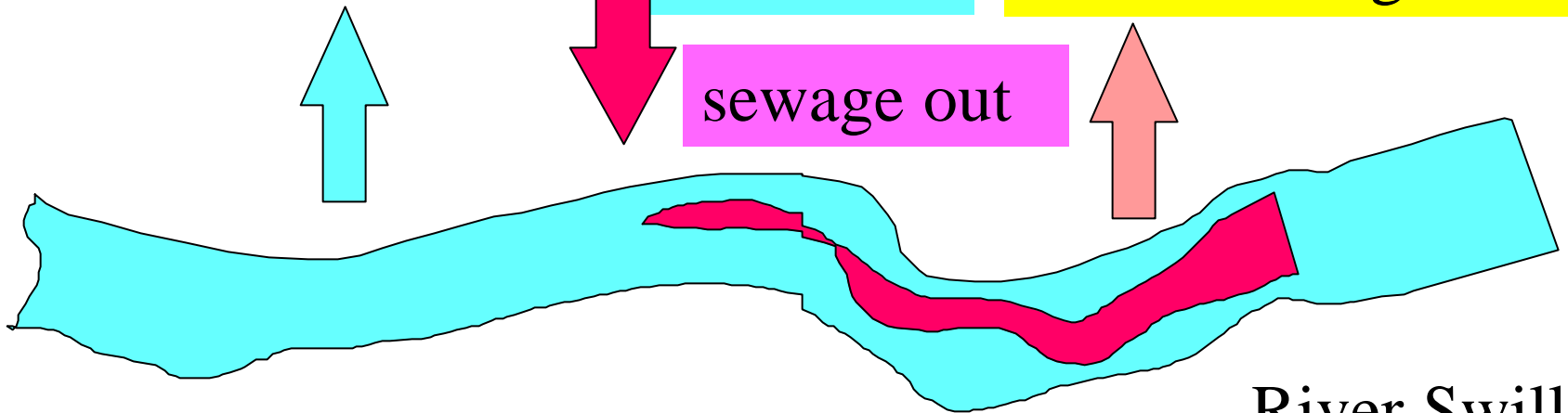
Place
associated
with
exposure
to a risk
factor for
a disease



clean water in

diluted sewage in...

sewage out



River Swill

3 Towns with river
drinking water....

Pristine
water
supply

leukemia rate
10/100,000

leukemia rate
1/100,000

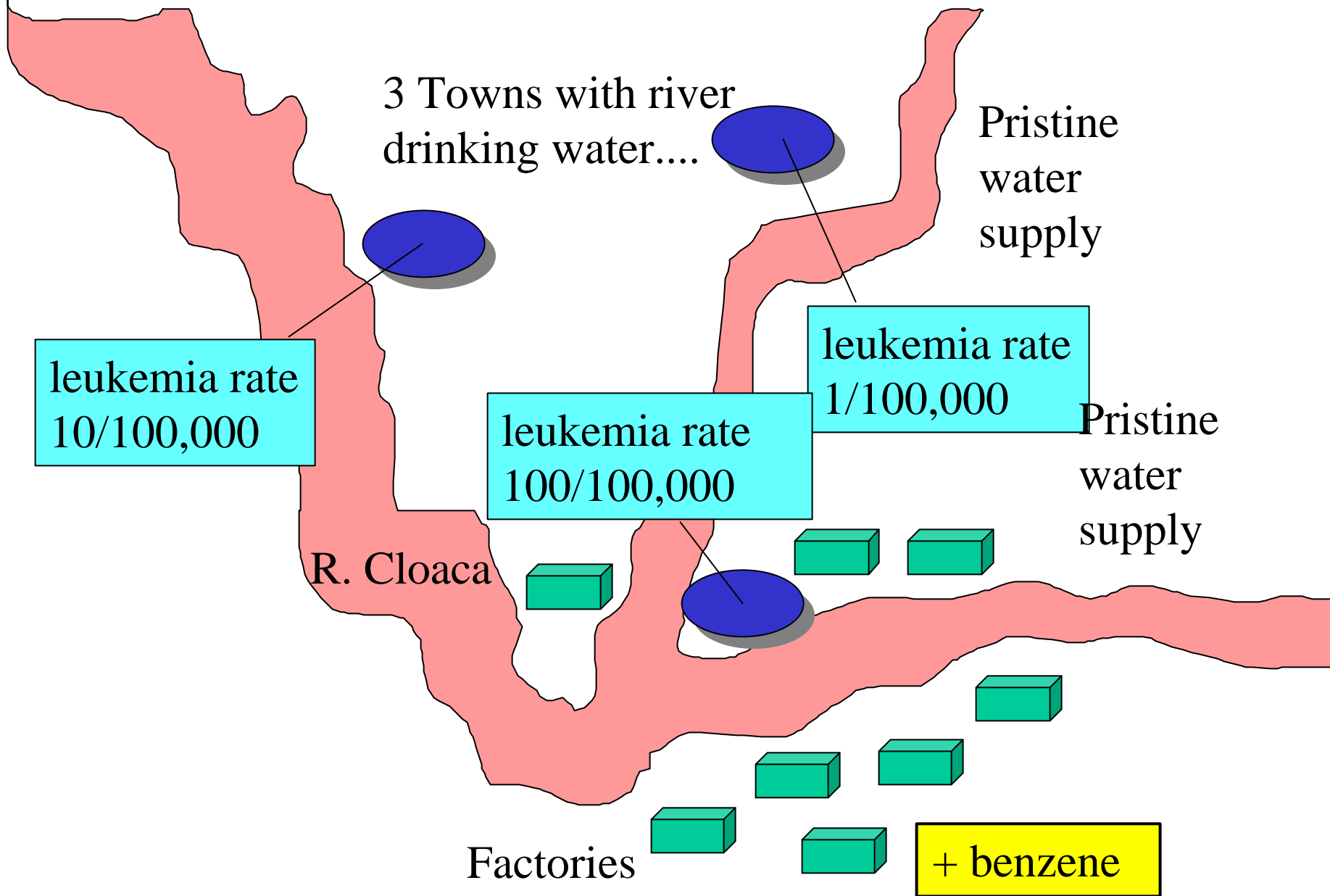
leukemia rate
100/100,000

Pristine
water
supply

R. Cloaca

Factories

+ benzene



- Dilution
- Degradation
- Breakdown of compounds,
biological transformation

.... These processes are dependent upon having sufficient water to dilute, time in the environment, etc. **Is this the case anymore?**

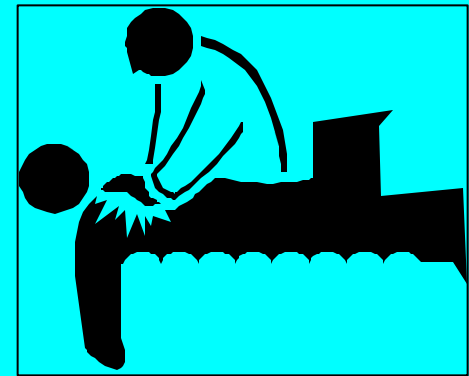
Rule #1. Keep shit out of your drinking water.

Rule #2. If you can't keep shit out of your water, kill the bacteria in the water.

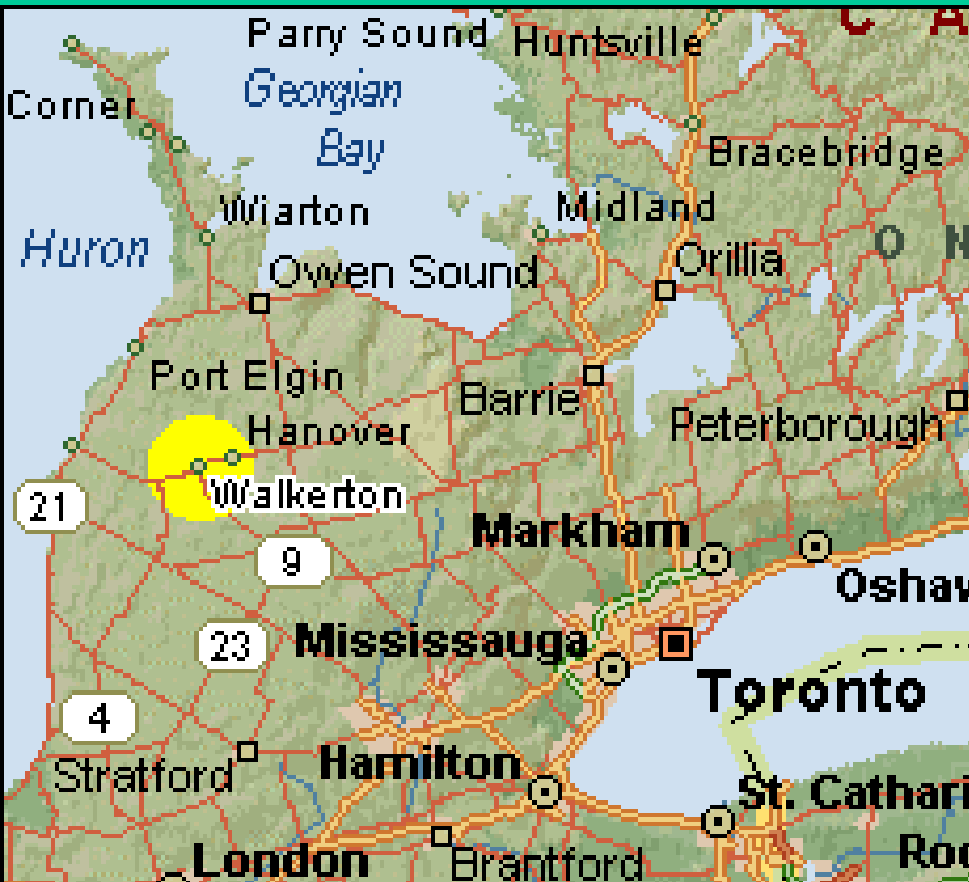
Rule #3. Never ever ever stop killing whatever it is in the water.

Why never stop?

- Walkerton Canada 2000
- People are still dumping their shit into your water.
- Human pathogens are excreted by humans, and drinking human shit is a great way to get exposure to the stuff that will make people sick.



Walkerton



- E. coli found in town's well water 5-7 times/yr
- Shallow wells, downhill from cattle farms
- Identified by consulting engineer as problem (78); ignored by regional gvt.
- Cycle of excess chlorine followed by use of less disinfectant when taste bad, and faked tests
- Rare inspections
- **April 2000 – chlorinator breaks down**

Walkerton Deaths and Illness

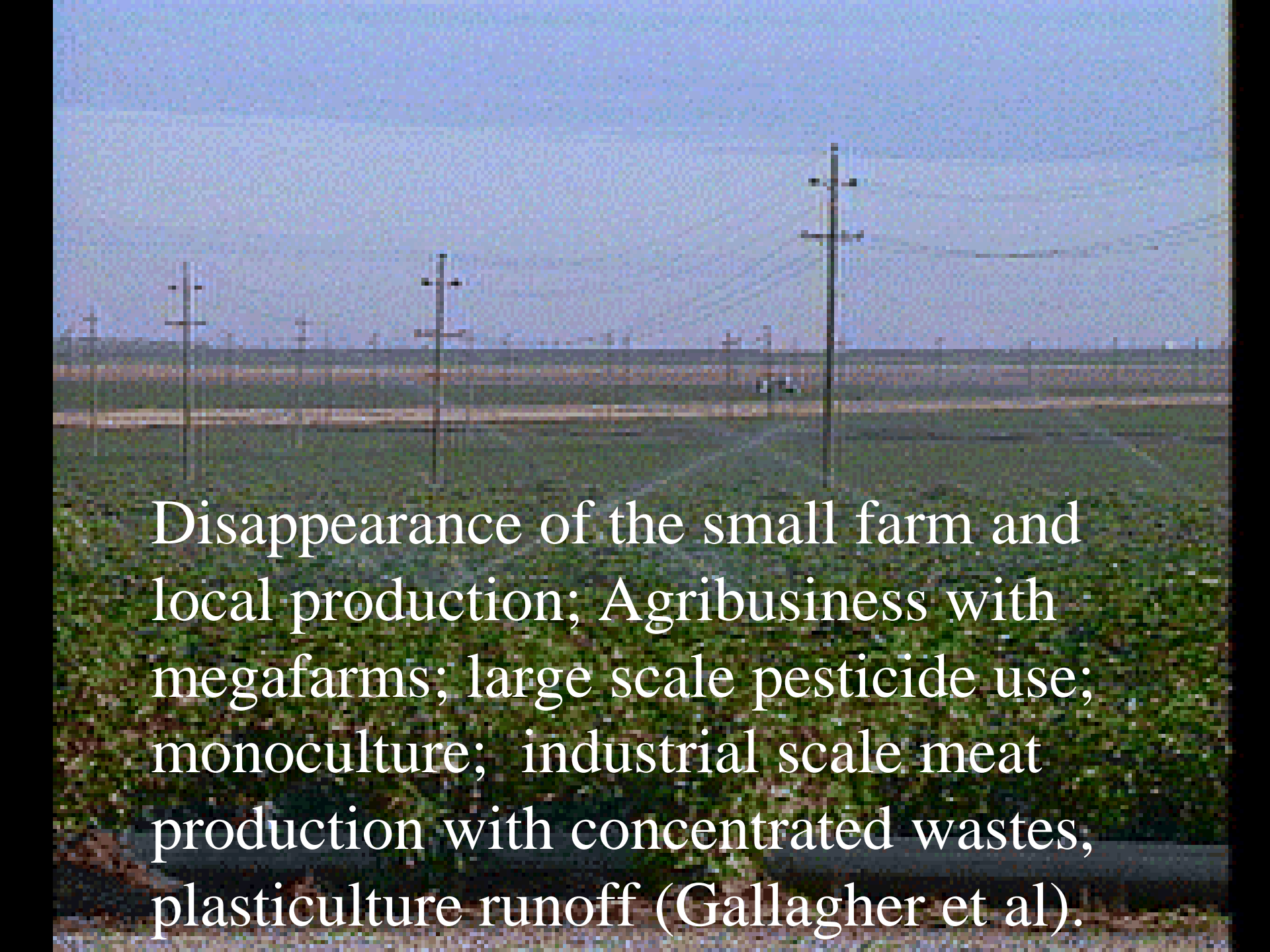


- 7 deaths, 27 HUS,* 65 hospitalized
- 2,321 people sick
- 42% of the cases were unreported

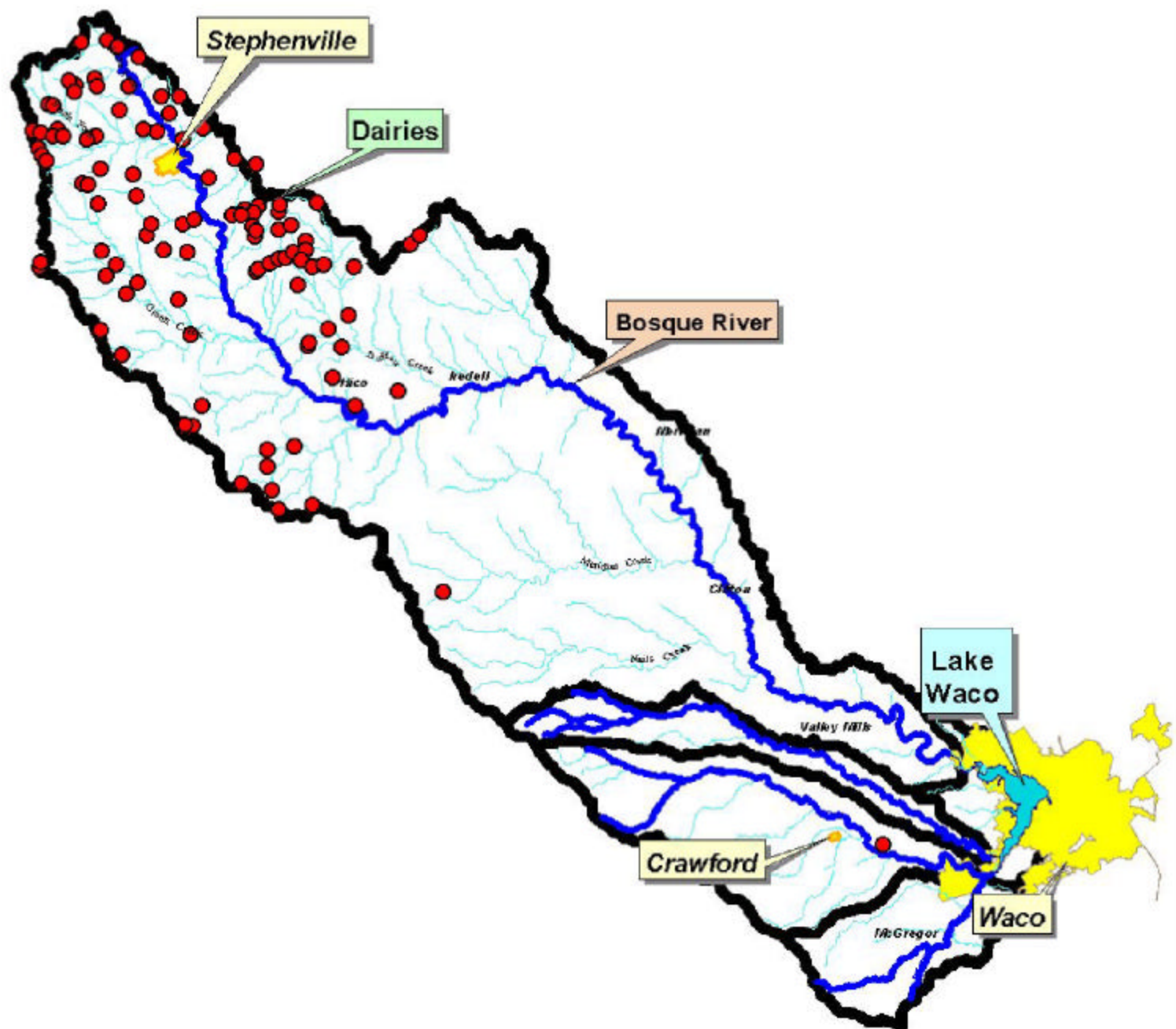
Hemolytic-uremic syndrome: renal failure, bleeding



How is the US different from an
hundred years ago? Or even
thirty?



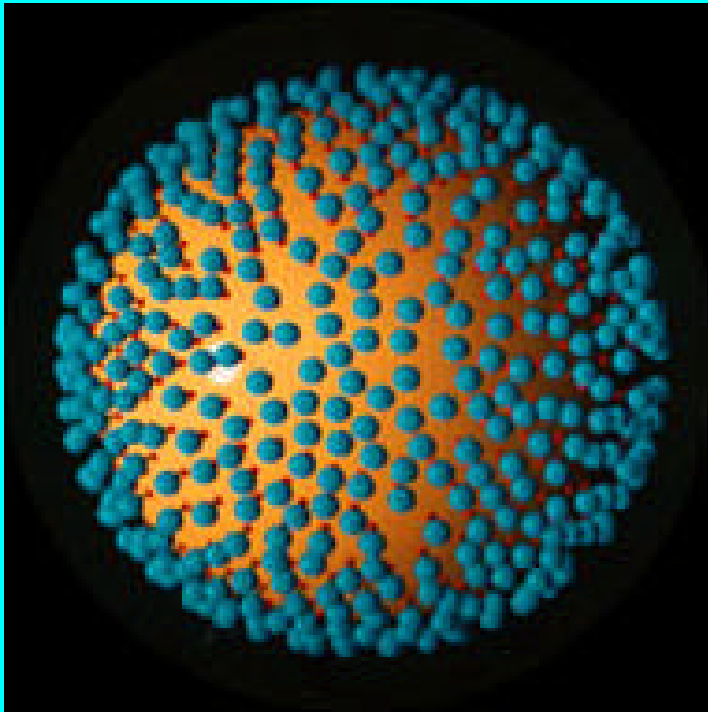
Disappearance of the small farm and local production; Agribusiness with megafarms; large scale pesticide use; monoculture; industrial scale meat production with concentrated wastes, plasticulture runoff (Gallagher et al).



Demographics - Population Density and Aging

- 1900: 76 million in the USA
- 2000: 275 million (US Census)
- 1800: 98% of the world rural
- 2000: 75% of US is urban (crowding)
- 2000: 6.1 billion people in the world
2050: 8 to 12 billion people

Emerging Diseases



HIV budding from cell

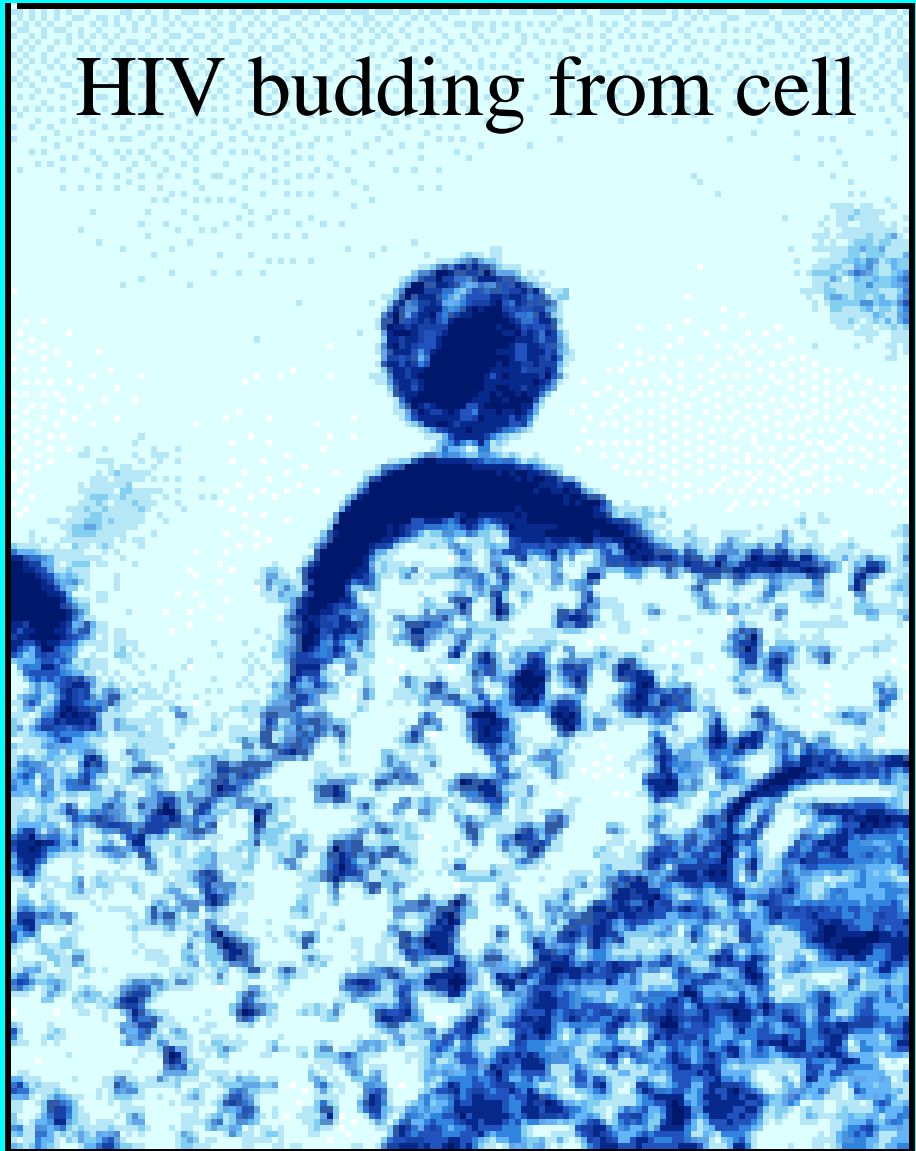
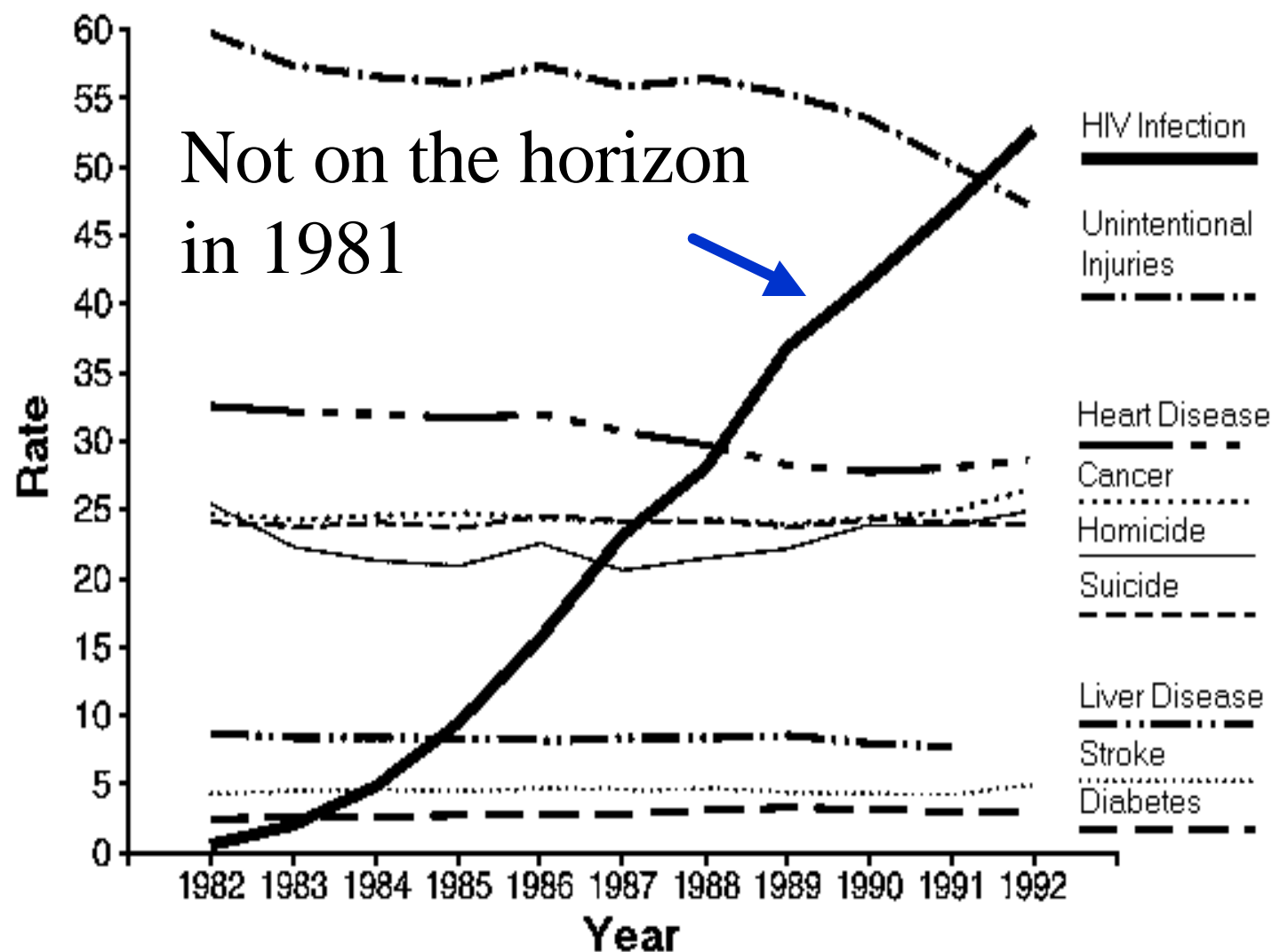


FIGURE 1. Death rates* from leading causes of death among men aged 25-44 years, by year – United States, 1982-1992+

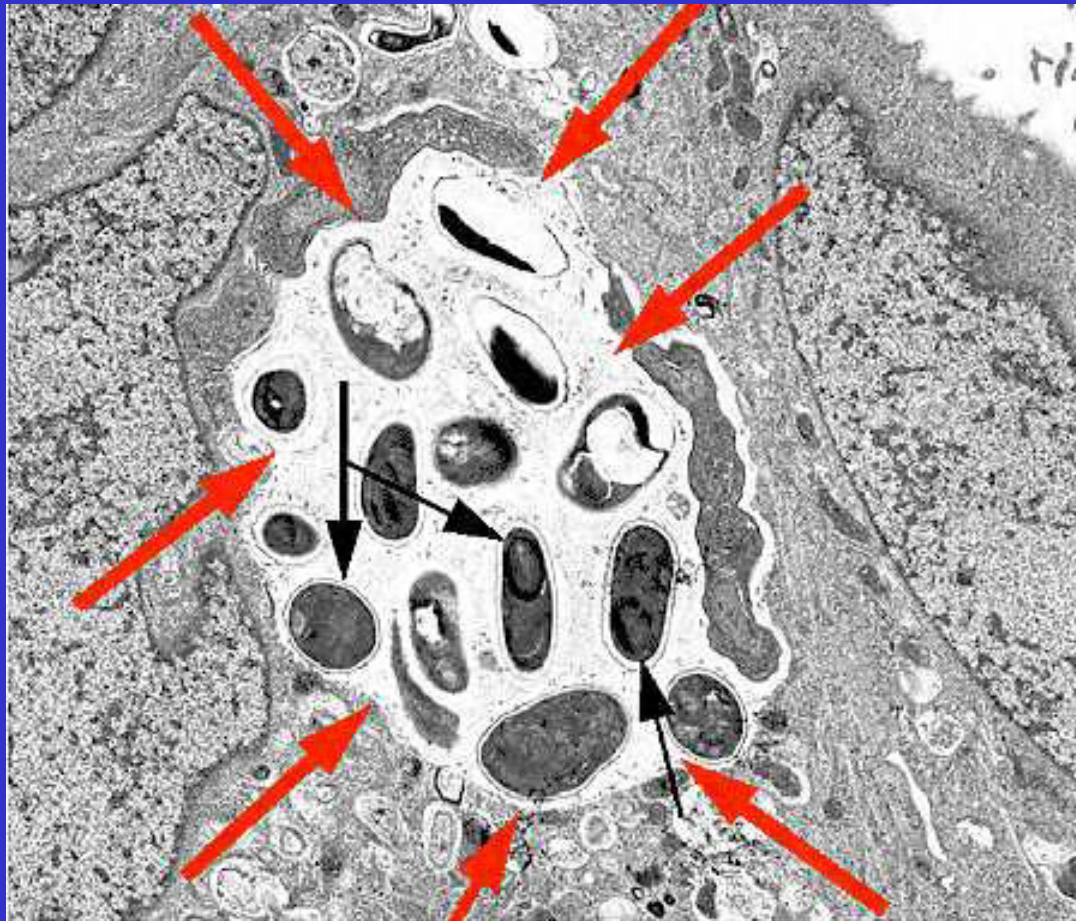
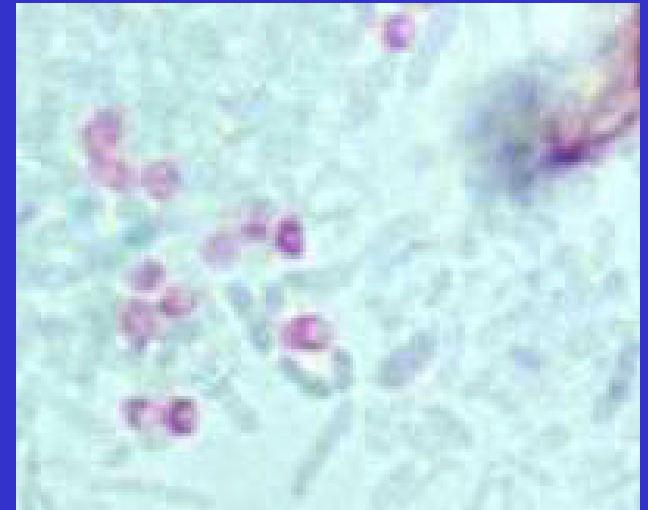


* Per 100,000 population.

+ National vital statistics based on underlying cause of death, using final data for 1982-1991 and provisional data for 1992. Data for liver disease in 1992 are unavailable.

Characteristics of Emerging Diseases:

- Resistance to chlorination / disinfection.
- Resistance to, or no, medical treatment.
- Zoonotic (animal) as well as human spread.
- A tiny inoculum can infect anyone.
- Severe clinical disease sometimes only in susceptible subpopulations.



Cryptosporidium

- Resistant to chlorination.
 - Present in 95% of surface waters (LeChevalier et al)
- 1993 Milwaukee outbreak:
403,000 people sick,
> 100 deaths, mostly people
with AIDS, children with
cancer

Milwaukee Sentinel Packer Plus Free sample inside
THURSDAY MORNING APRIL 8, 1993 ***** EDITION

Boil water, mayor says

Safety of drinking supply probed in wake of mystery epidemic

By GRETCHEN SCHULTZ
Sentinel staff writer

Metropolitan Milwaukee residents were told Wednesday night to boil their water before drinking it or using it to clean food because of a recent outbreak of digestive illness.

Mayor John O. Norquist said today he might people who caught the illness found a type of organism that can be waterborne.

The report suspends about the water supply, which originates in Lake Michigan and serves Milwaukee and 13 suburbs.

The outbreak has struck thousands of people with diarrhea, stomach cramps, vomiting and fever. Some schools have been shut down. No deaths have been reported.

Norquist issued the advisory at 4:30 p.m. news conference Wednesday.

Water should be boiled for at least 5 minutes, officials said. The advisory said those with weakened immune systems should be especially careful.

"It is not certain the water supply is at fault, Norquist said.

"We are erasing on the side of caution," he said. "We do not know enough if where it came from. We are not sure sure it's from the water supply."

The organism is called *Cryptosporidium*, a rare, microscopic parasite.

While there is no cure but time, common over-the-counter medications can relieve the symptoms, officials said.

It will take several days to determine whether the organism is in the water supply, Health Commissioner Paul W. Hensle said.

Special Deputy Commissioner "Reverend" Arthur Thomas said hundreds of gallons of water must be collected to get enough sediment to test for the organism.

See Water 12A See Epidemic 8A



Water scare: The Wegmans drug store right at 2800 N. Oakland Ave. assures customers that it has what many people may need most these days — an anti-diarrheal medicine. Heather Guttman, a sales clerk in the store, was drinking spring water Wednesday night. She said her customers were it and she don't want to get sick.



Water scare: The Wegmans drug store right at 2800 N. Oakland Ave. assures customers that it has what many people may need most these days — an anti-diarrheal medicine. Heather Guttman, a sales clerk in the store, was drinking spring water Wednesday night. She said her customers were it and she don't want to get sick.

Bottled water buyers deluge stores

By JAMES E. CAUSEY
Sentinel staff writer

Milwaukee-area residents flooded grocery stores late Wednesday night to buy bottled water after city officials announced that a parasite in the city's water supply might be responsible for a major outbreak of digestive illness.

Pat Carbaugh, manager of Cub Food Store, 4061 N. 54th St., said the last hour "we've sold about 100 gallons of bottled water," Carbaugh said.

The supermarket, normally would sell about five gallons of water during that time, Carbaugh said.

"People were buying six or seven gallons of water at a time," Carbaugh said.

"We've been wiped out," said

At the Sentry supermarket, 2830 N. Oakland Ave., one man filled a shopping cart with bottled water.

Every third customer in the

had at least two bottles of water in their cart, a store clerk said.

Most shoppers spent for 24-gallon bottles. Everyone in line was talking about the almost panic being caused by the water.

One store clerk said she asked a stock boy to save some bottled water for her because she didn't know what to do.

Walt Lewandowski, assistant manager of Pick 'N Save Warehouse Foods, 9200 N. Green Bay Road, said the store sold out of water shortly before 11 p.m.

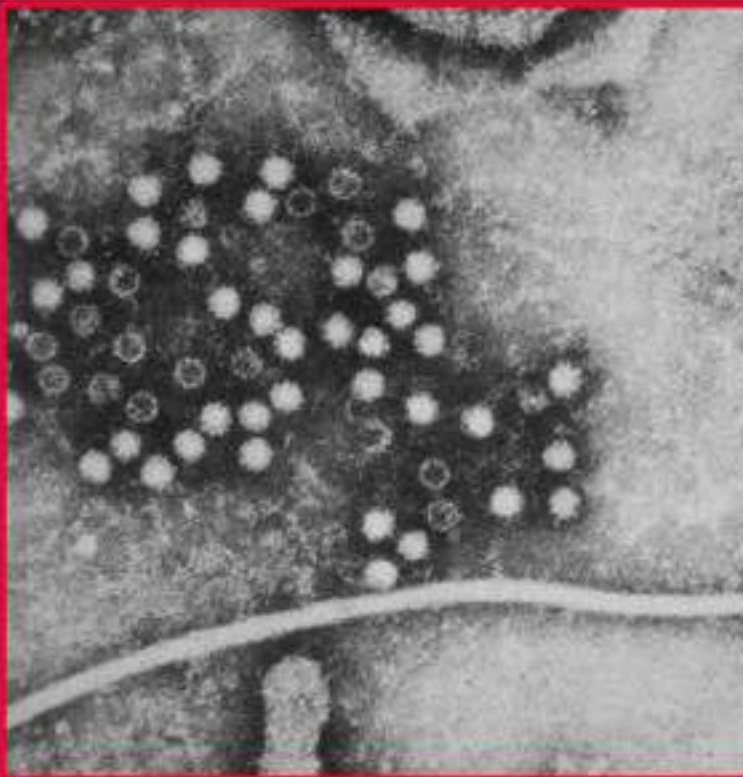
"We were not prepared for this," Lewandowski said. "We sold over 30 cases of water within a matter of hours."

In addition to selling out of

See Water 12A See Epidemic 8A

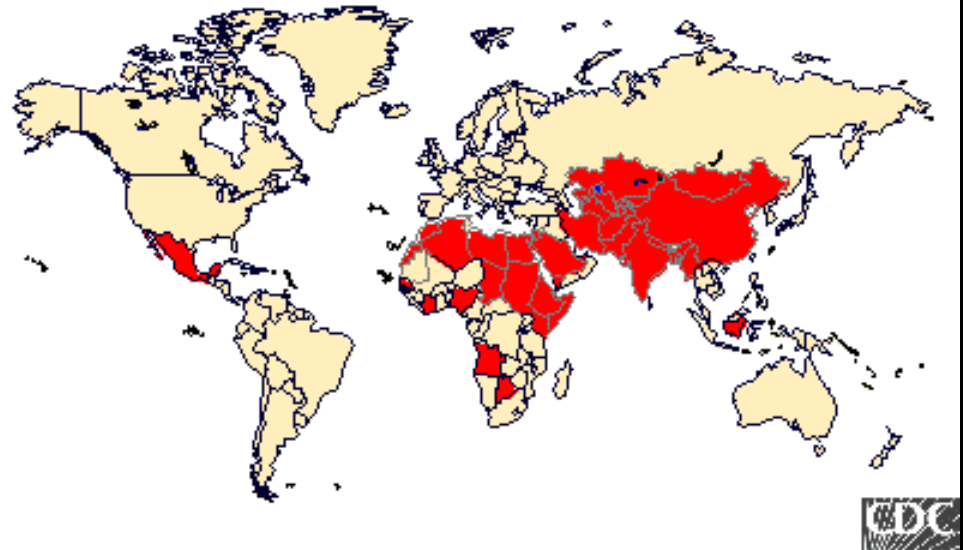
GOP budget boss warm to tax freeze 'adjustments'

Hepatitis E Virus



Geographic Distribution of Hepatitis E

Outbreaks or Confirmed Infection in > 25% of Sporadic Non-ABC Hepatitis



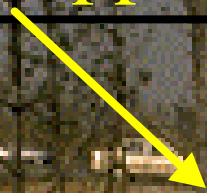
Case-fatality 1-3% Pregnant Women, 15-25%

Most outbreaks with fecally contaminated water

Severity Increases with Age Virus very similar to a swine virus

Ill people are living longer

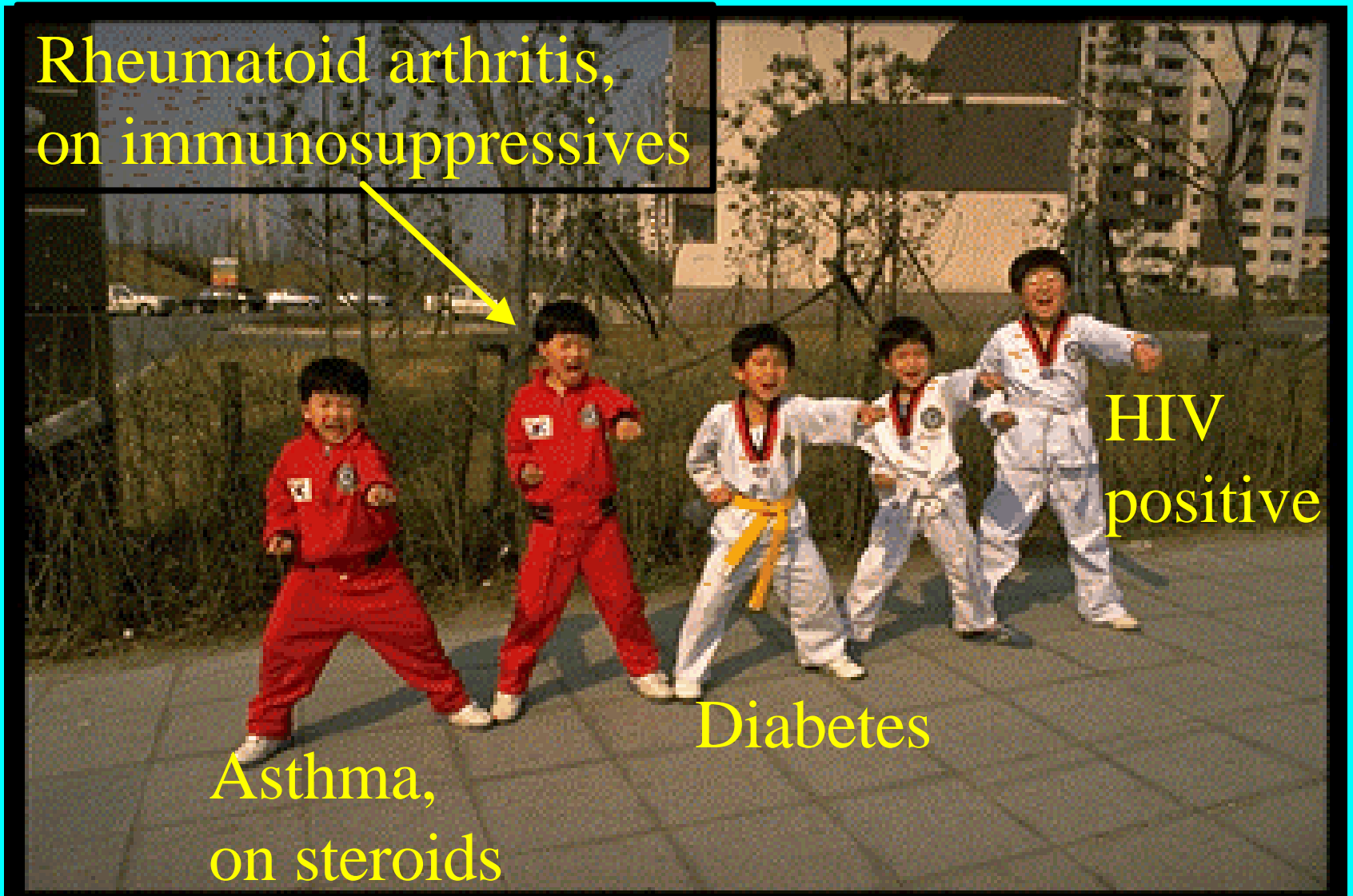
Rheumatoid arthritis,
on immunosuppressives



HIV
positive

Diabetes

Asthma,
on steroids



Who are some of the sensitive?

- People with AIDS
- Infants & young children, pregnant women
- If on chemotherapy / immuno-suppressive treatment, on dialysis, have had a transplant
- The frail, poorly nourished, chronically ill
- Substandard care, the poor, limited access
- People with genetic dispositions to specific diseases or malignancies.

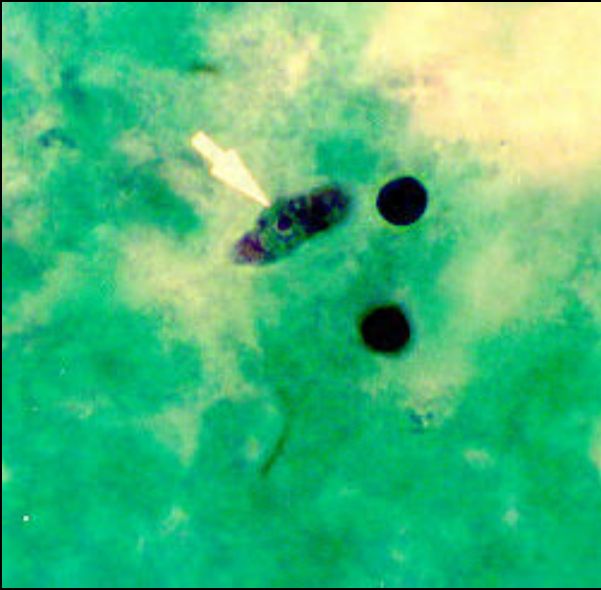
Source water protection I

- Environmentally sound
- Lowers the cost of water treatment for drinking water purposes
- Lowers exposures to chemicals needed in the disinfection process
- No treatment is perfect or 100% secure; adds an extra layer of safety to the drinking water supply in case treatment fails

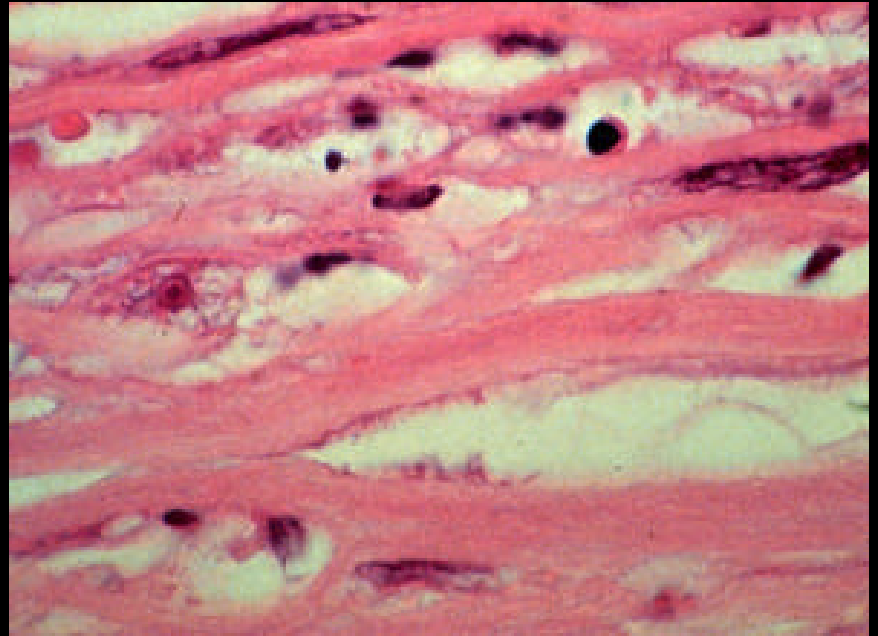
Source water protection II

- If you can't completely or reliably remove an emerging pathogen from drinking water (e.g. *Cryptosporidium*) –
- Then keeping it out of the water is a good public health solution – this prevents exposure to the pathogen in susceptible as well as normal populations.

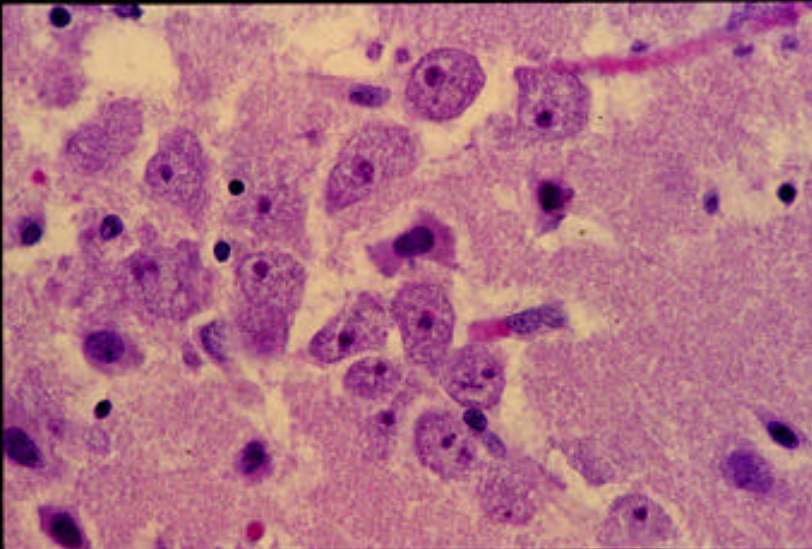
Naegleria fowleri & *Acanthamoeba*



In CSF



Keratitis



In Brain

Rule #1. Keep shit out of your drinking water.

Rule #2. If you can't keep shit out of your water, kill the bacteria in the water.

Rule #3. Never ever ever stop killing whatever it is in the water.

Rule # 4. While you kill everything under the sun, leave absolutely no traces.

Chlorination byproducts & cancer risk

- Estimate: 1,000-10,000 cases of bladder cancer / year due to chlorination.
- More than 50 studies suggest a link between DBPs and adverse reproductive outcomes
- Reasonable trade-off in 1900; what about now?

Study ties cancer, chlorinated water

By JOE MANNING
Sentinel staff writer

A Medical College of Wisconsin researcher has found "a significant link" between chlorinated drinking water and thousands of bladder and rectal cancer cases.

Robert D. Morris, working with researchers from Harvard University School of Public Health, said 4,200 cases of bladder cancer and 6,500 cases of rectal cancer could be linked to chlorination.

Drinking-water chlorination accounts for 9% of the bladder cancer cases and 18% of the rectal cancers, Morris said.

The research suggests that cancers of the bladder and rectum may occur because both store waste products for periods of time.

Morris said he and colleagues researched 10 scientific papers dealing with cancer and chlorination of drinking water to reach his conclusion.

Most of the papers individually failed to show any link, but when the information was combined, a strong association between bladder and rectal cancers and exposure to chlorination byproducts in drinking water was shown, he said.

"When combined, you increase your statistical power and find the risks are significant," he said. The study was published in the July issue of the American Journal of Public Health.

About 75% of the nation's drinking water is chlorinated surface water, such as lakes, reservoirs and rivers. Groundwater, especially when drawn from private wells, is generally not chlorinated.

See **Water** / 11A

Rule #1. Keep shit out of your drinking water.

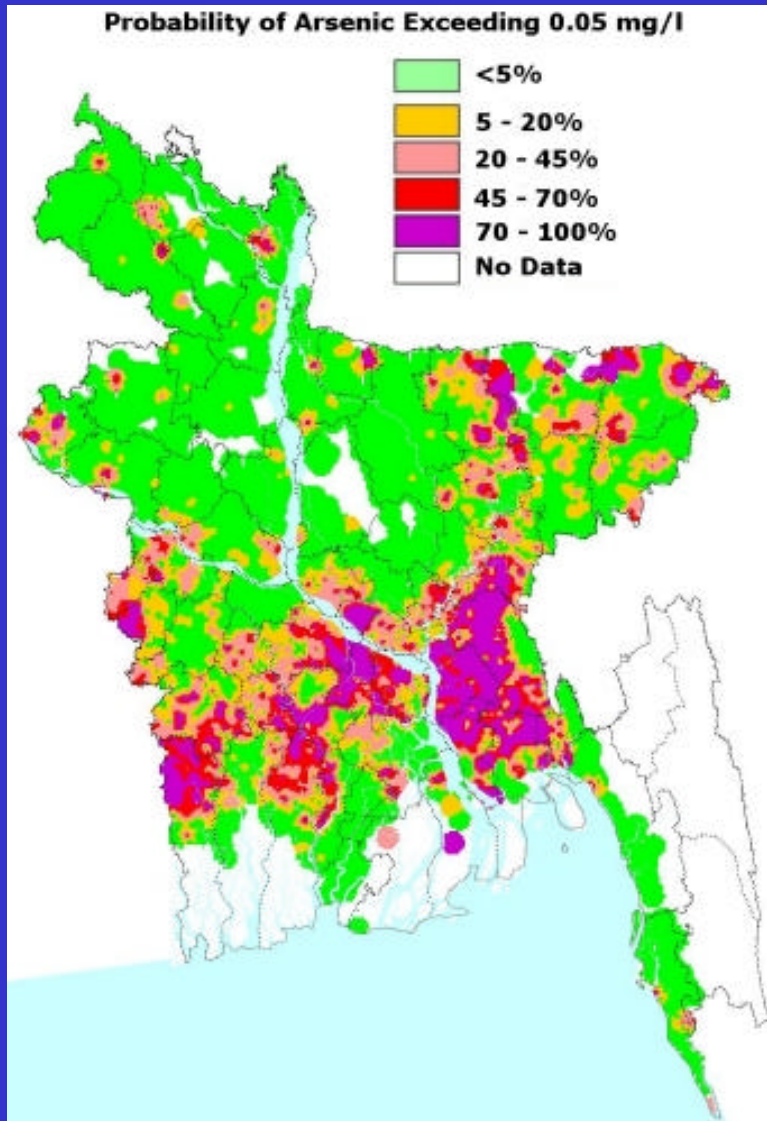
Rule #2. If you can't keep shit out of your water, kill the bacteria in the water.

Rule #3. Never ever ever stop killing whatever it is
in the water.

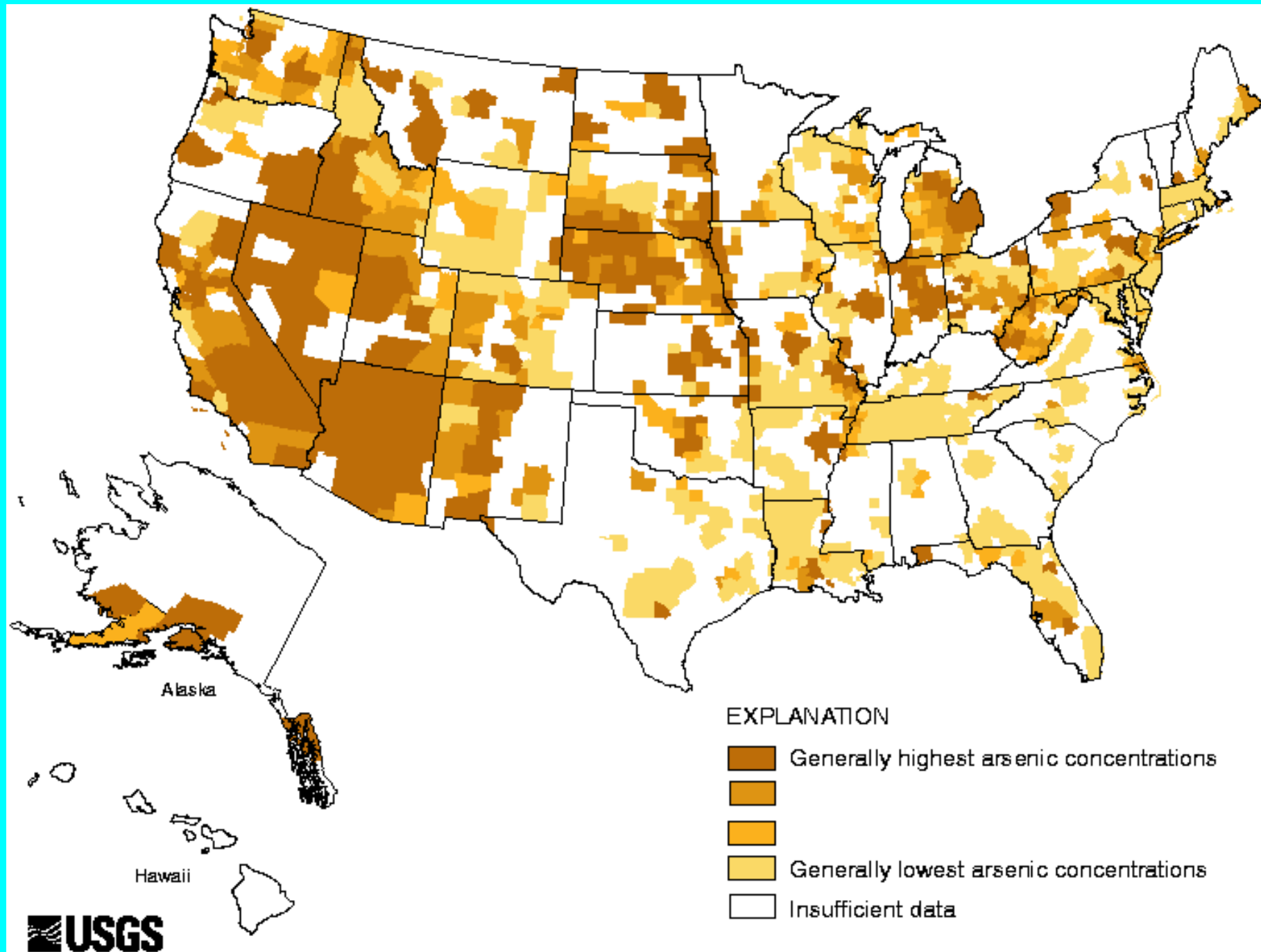
Rule # 4. While you kill everything under the
sun, leave absolutely no traces.

**Rule #5. While doing all of the
above, figure out how to remove
naturally occurring and man-made
minerals and synthetic chemicals.**

Chemicals / Heavy Metals



- LEAD – plumbism
- ARSENIC
- RADON - lung cancer
- URANIUM - cancers
- NITRATES - especially for pregnant women and children < 1 year of age
- MERCURY - poisoning
- PCBs - cancers, reproductive
- PESTICIDES - can be a major occupational risk for migrant and agricultural workers
- HORMONE analogs...



Rule #1. Keep shit out of your drinking water.

Rule #2. If you can't keep shit out of your water, kill the bacteria in the water.

Rule #3. Never ever ever stop killing whatever it is in the water.

Rule # 4. While you kill everything under the sun, leave absolutely no traces.

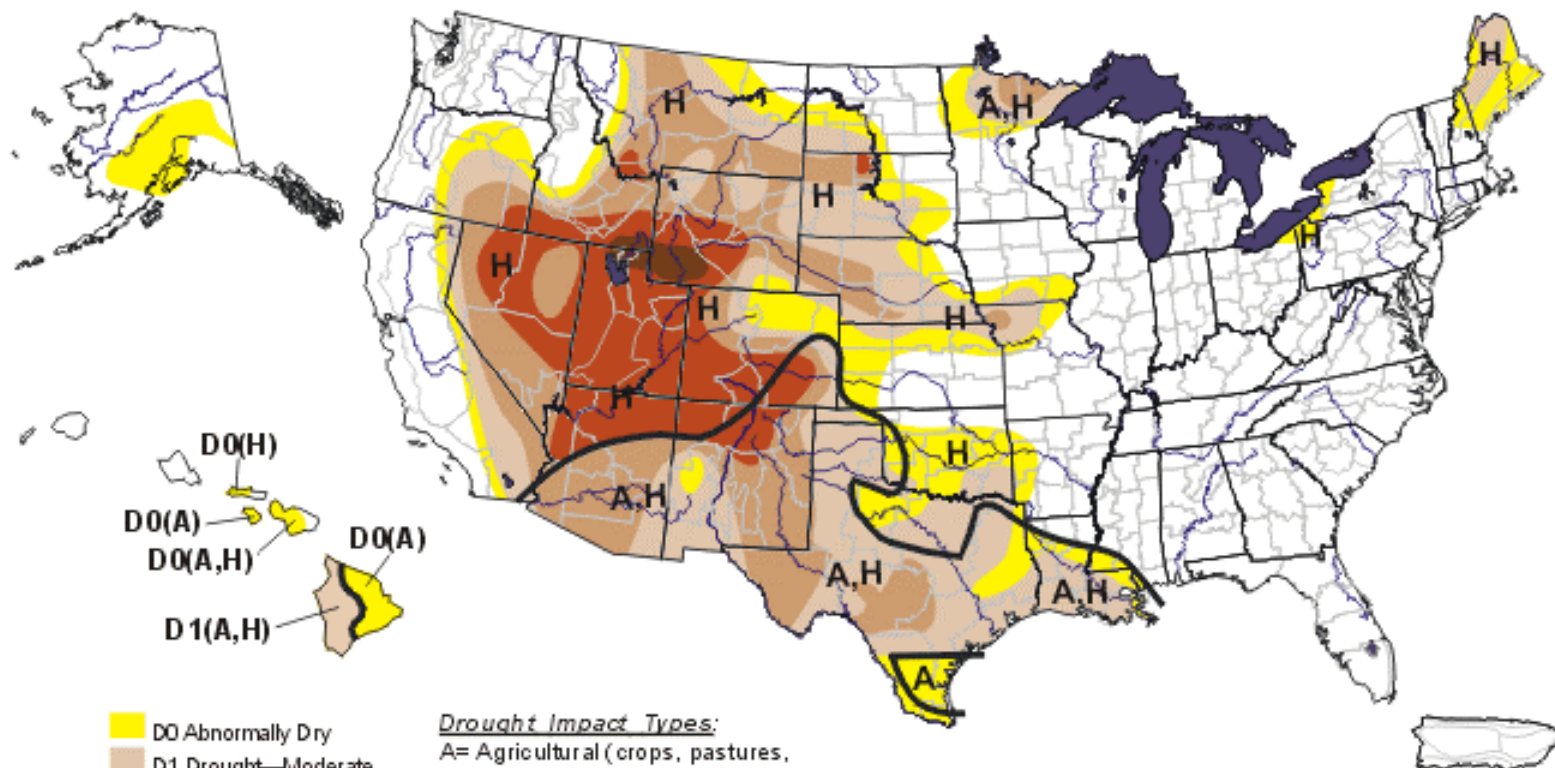
Rule #5. While doing all of the above, figure out how to remove naturally occurring and man-made minerals and synthetic chemicals.

Rule #6. Do this with less water and while using sewage (see #1).

U.S. Drought Monitor

May 27, 2003

Valid 8 a.m. EDT



- D0 Abnormally Dry
- D1 Drought—Moderate
- D2 Drought—Severe
- D3 Drought—Extreme
- D4 Drought—Exceptional

Drought Impact Types:

- A= Agricultural (crops, pastures, grasslands)
- H= Hydrological (water)
- Delineates dominant impacts (No type = both impacts)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

<http://drought.unl.edu/dm>



Released Thursday, May 29, 2003

Authors: Richard Heim/Candace Tankersley, NOAA/NCDC

Changing world demands fresh look

Changing population
More chronic illness
Susceptible populations
New pathogens
Less water
Aging infrastructure
More concern re: chemicals

8 27 2002

Big Picture: Key Points

- Integration of source water, drinking water, and wastewater treatment is inevitable. This will increase, not decrease, risk levels.
- What was good in 1925 won't cut it in 2025. The population is changing, and so is the environment.
 - Source water protection is a key element to solving the issues before us. Fundamental public health protection is at stake.

Novel Research Information

Climate Variability – More ‘Extreme Events’



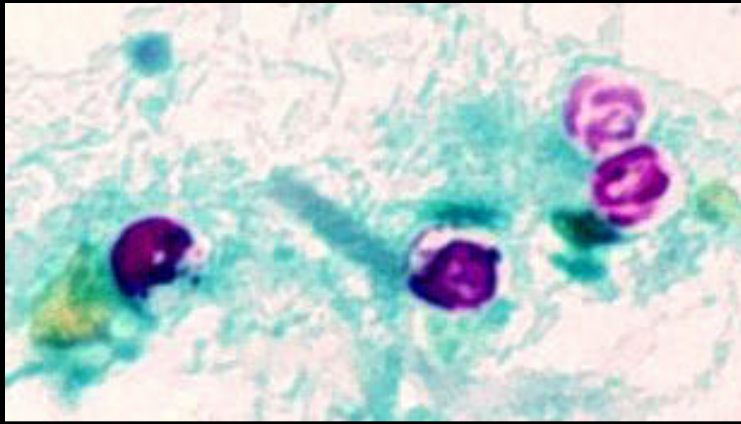
Extreme Events = floods, surges.... Source waters are contaminated or degraded....



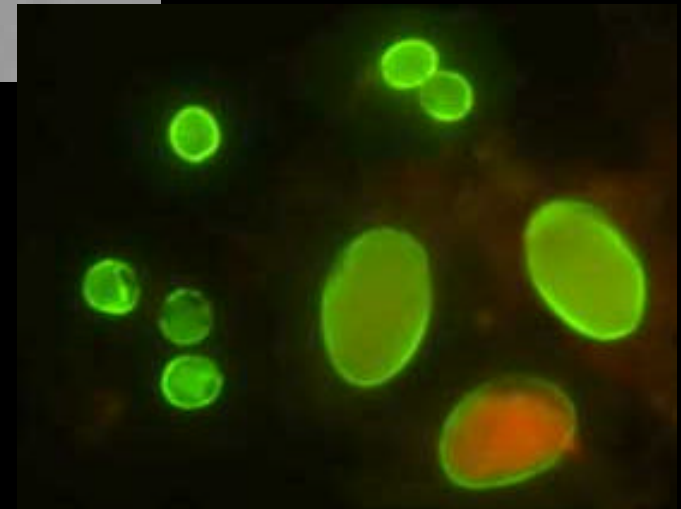
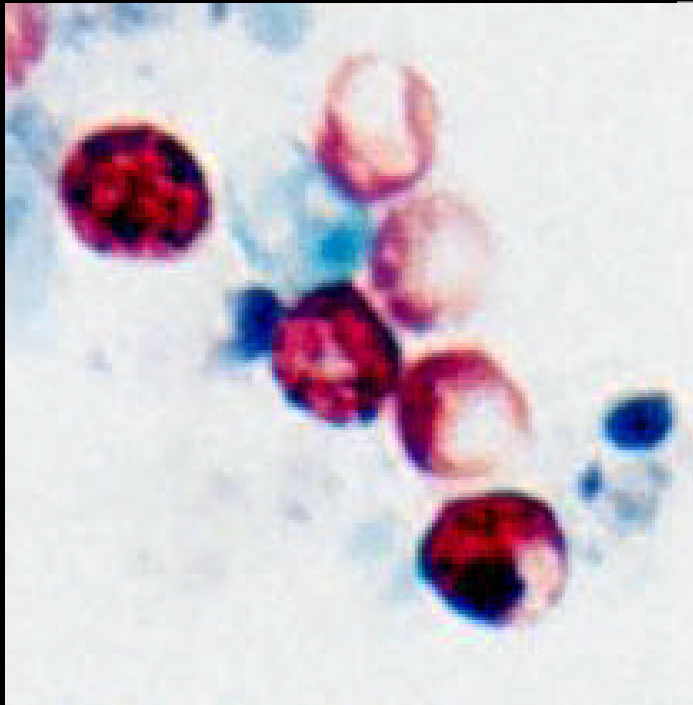
Drinking water treatment overwhelmed...



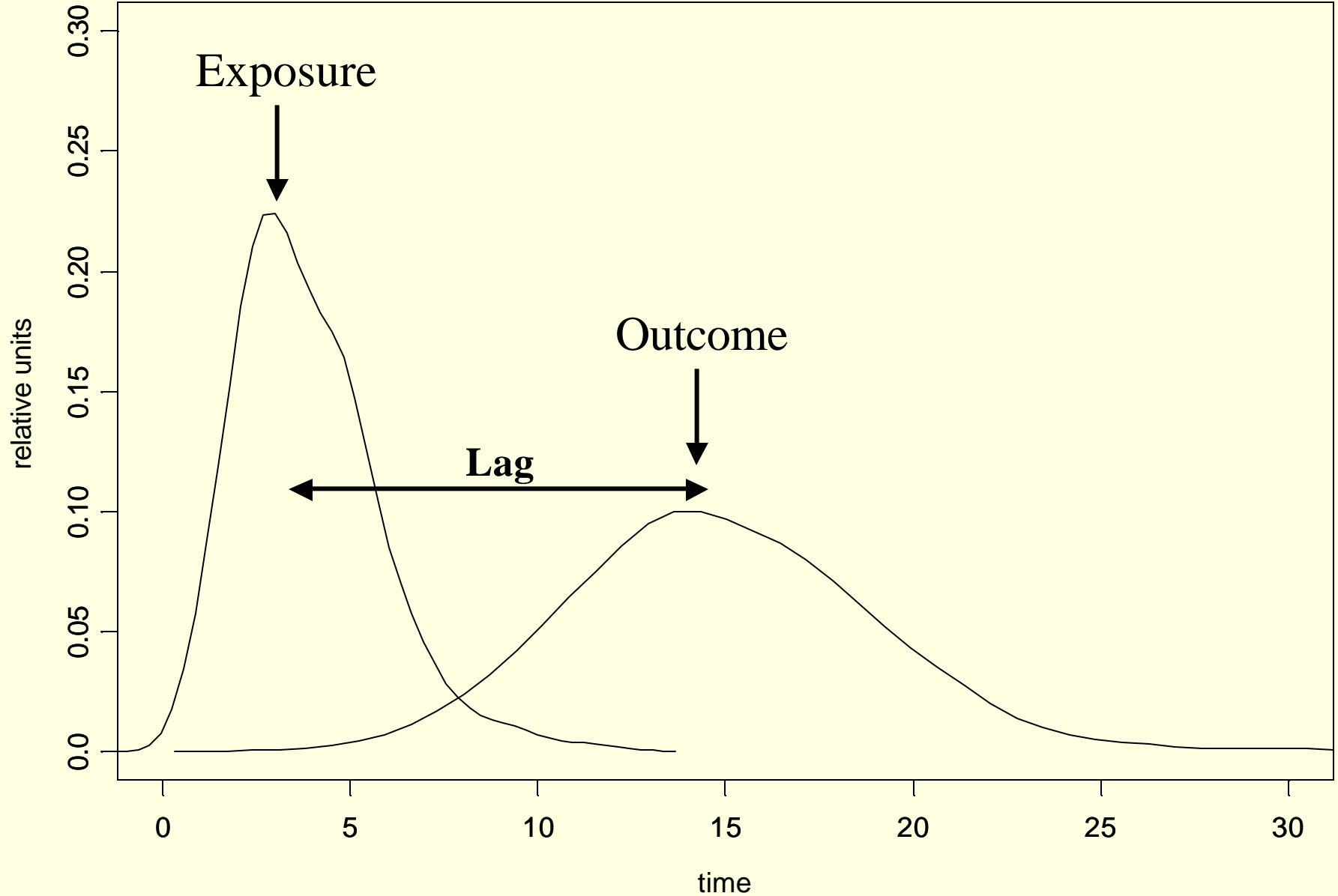
Increased Risk for the human population

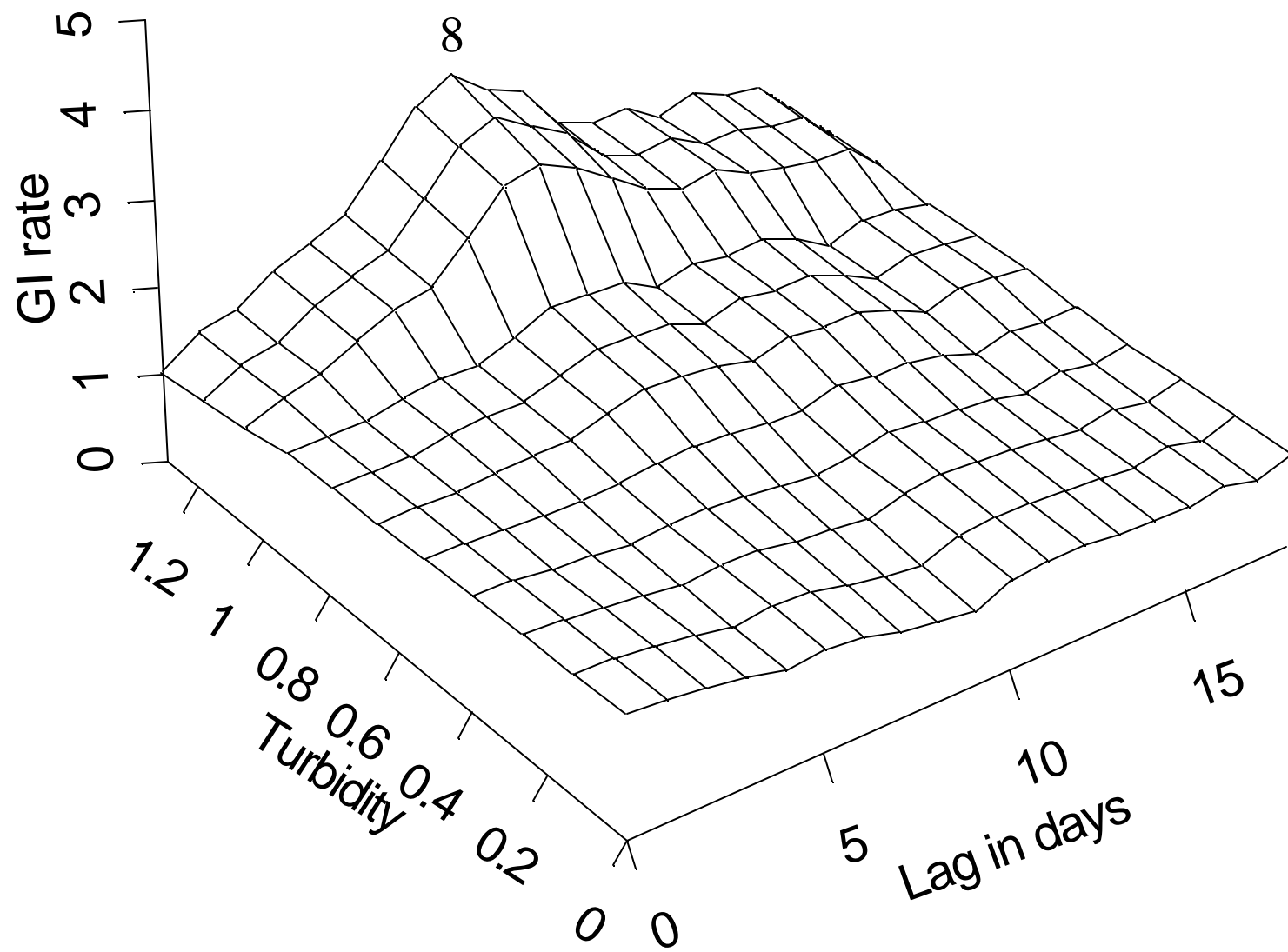


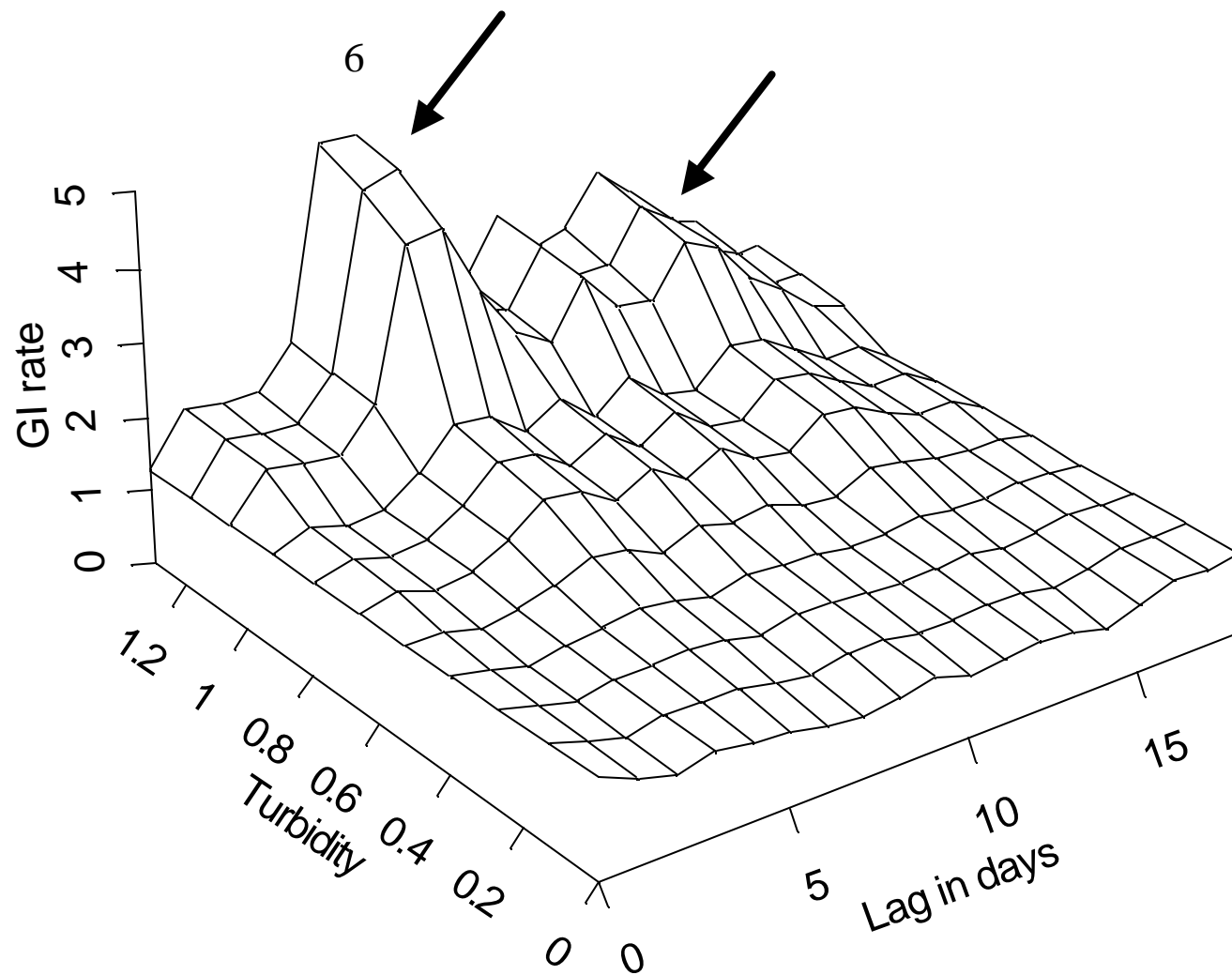
Cryptosporidium parvum
-concentrations increase
~ 50 fold with rainstorms



Time Series: Ideal 1







Naumova *et al.* The Elderly and Waterborne *Cryptosporidium* Infection: Gastroenteritis before and during the 1993 Milwaukee Outbreak. *Emerging Infectious Diseases* 9:418-425 2003